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Kinme et al.

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(54) **TILT STEERING ASSEMBLY**

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H02K 7/02 (2006.01)
H02K 5/00 (2006.01)

(52) **U.S. Cl.** **74/493**; 280/775; 310/71; 310/89

(58) **Field of Classification Search** ..... 74/492, 74/493, 388 PS; 180/444; 280/779, 775
See application file for complete search history.

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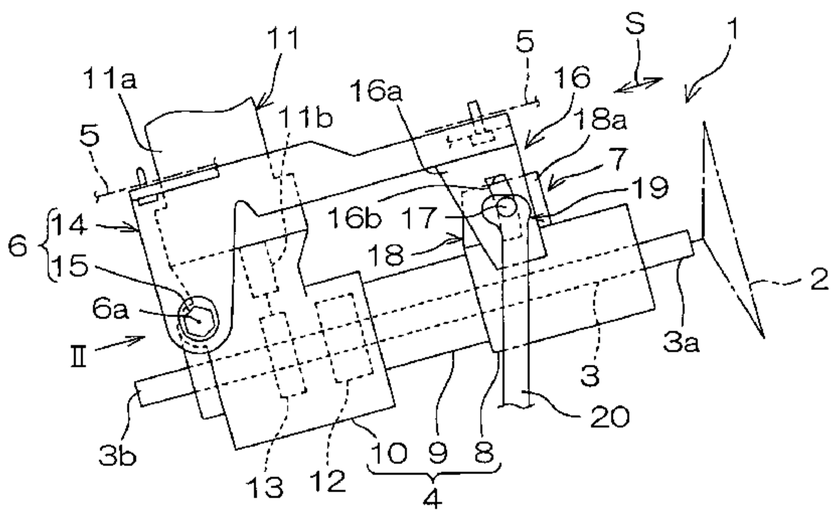
(57) **ABSTRACT**

A tilt steering assembly includes a support shaft extended along a tilt central axis. The support shaft is conductively assembled to a steering column and is unitarily rotated with the steering column during tilt adjustment. A resilient conductive member is interposed between a conductive end member provided at an end of the support shaft and a conductive fixed side plate including a support hole for supporting the support shaft. The steering column is grounded via the support shaft, the end member, the conductive member and the fixed side plate.

15 Claims, 8 Drawing Sheets



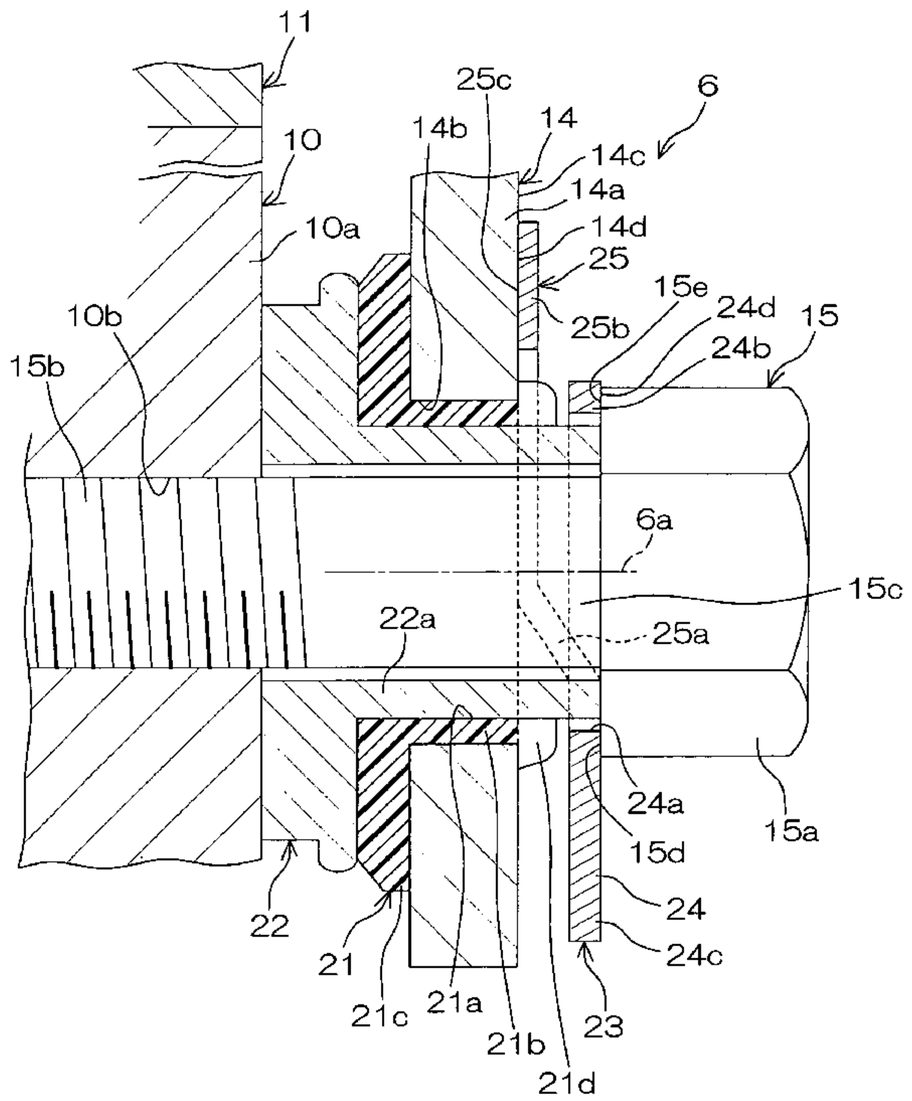


FIG. 1A

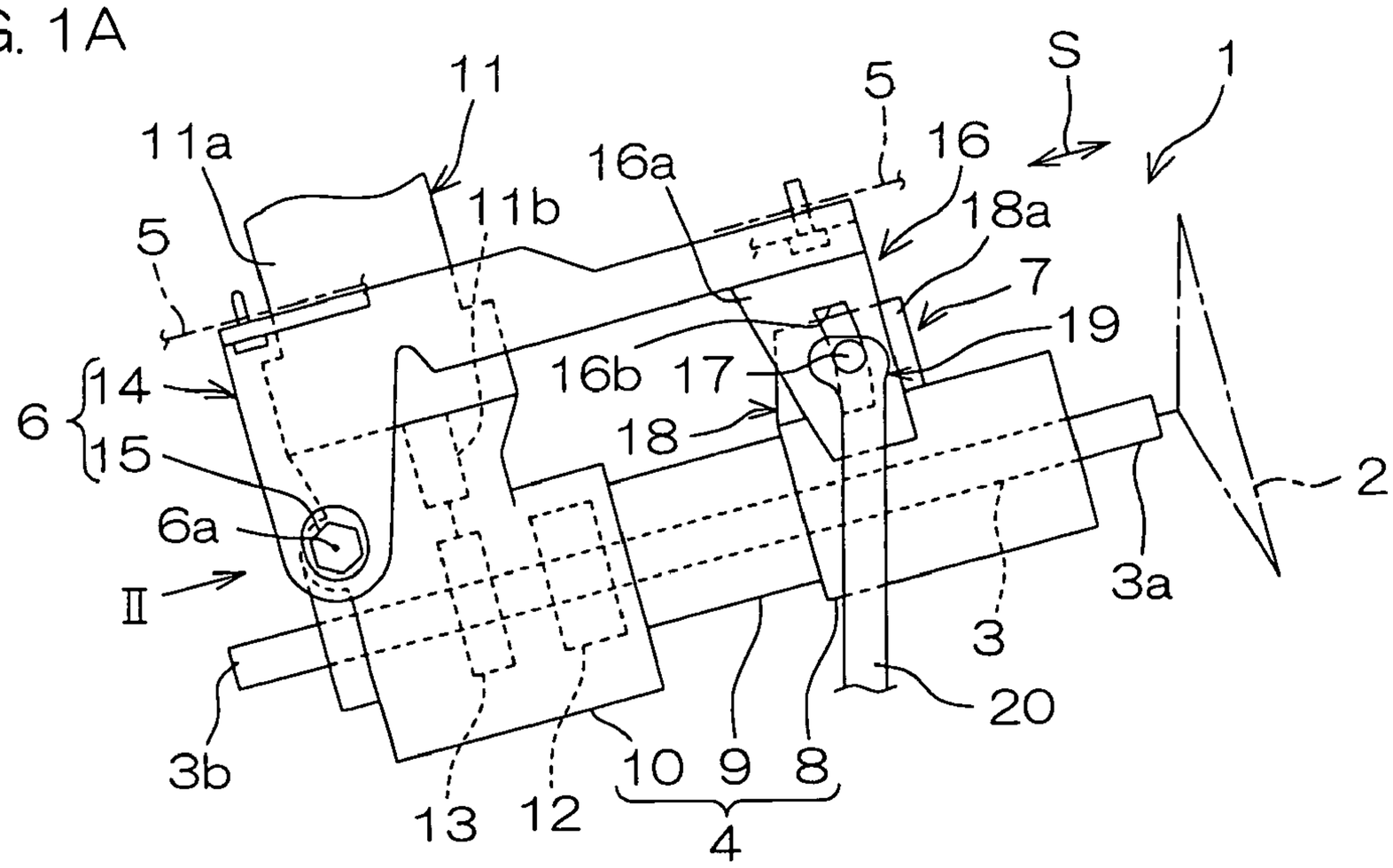


FIG. 1B

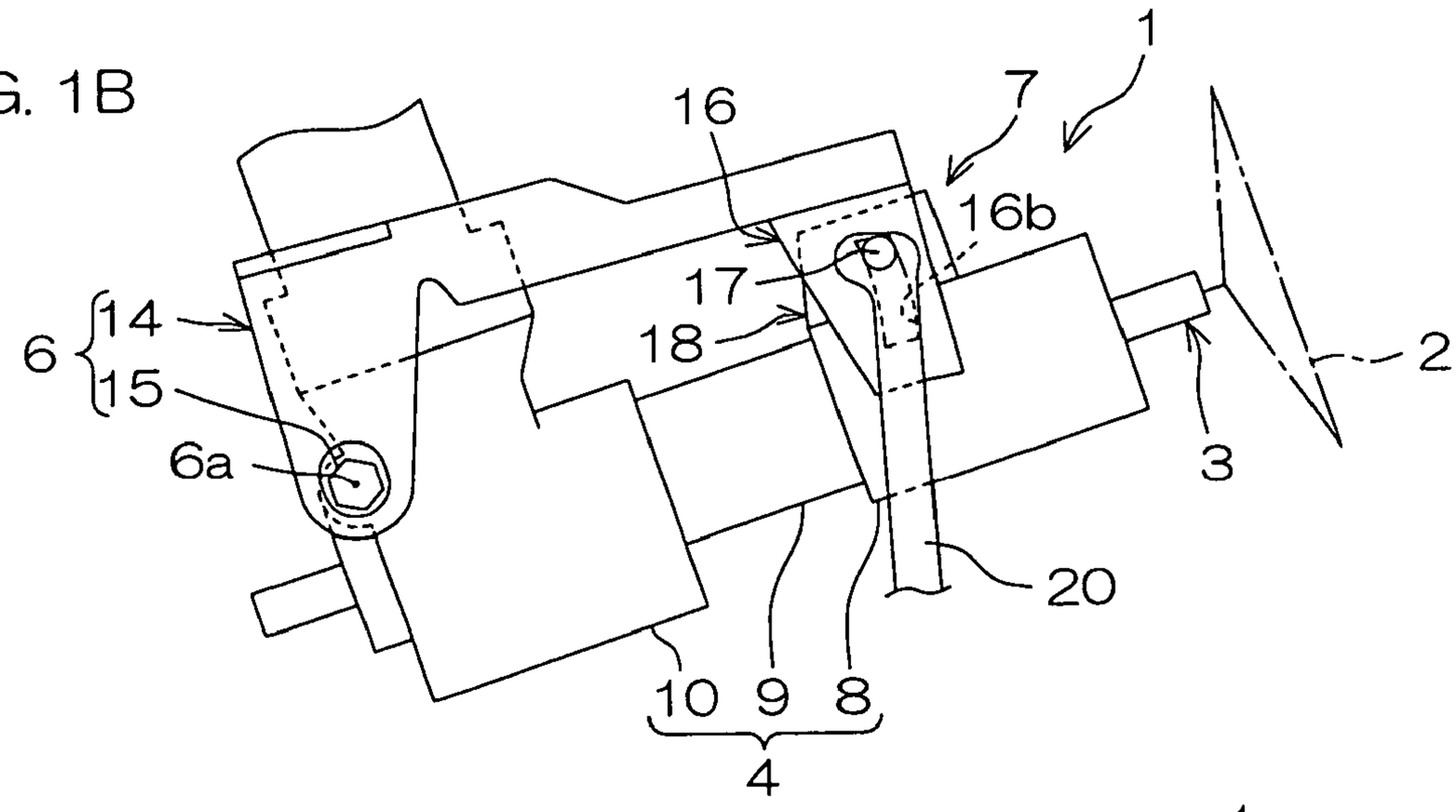


FIG. 1C

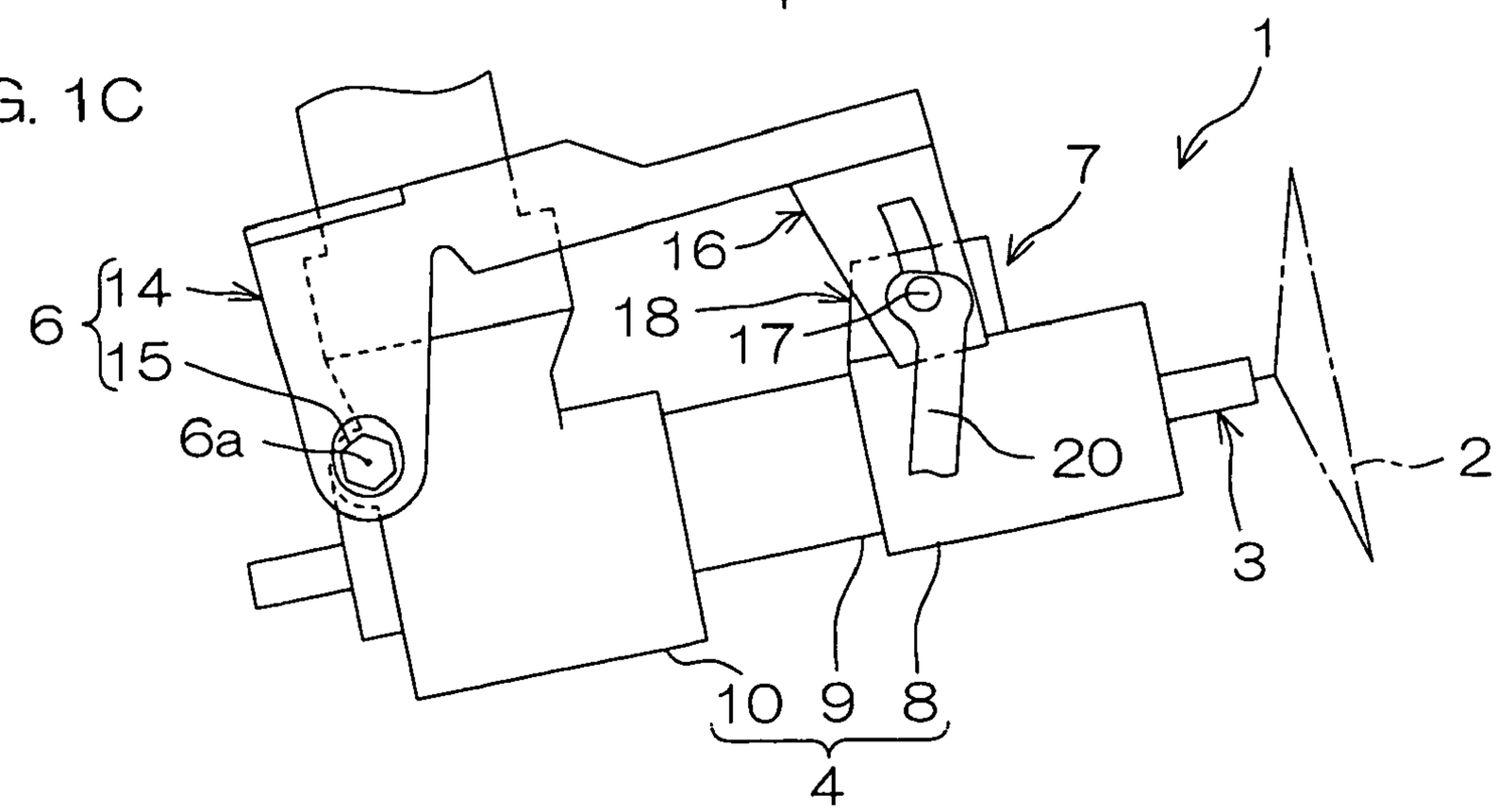
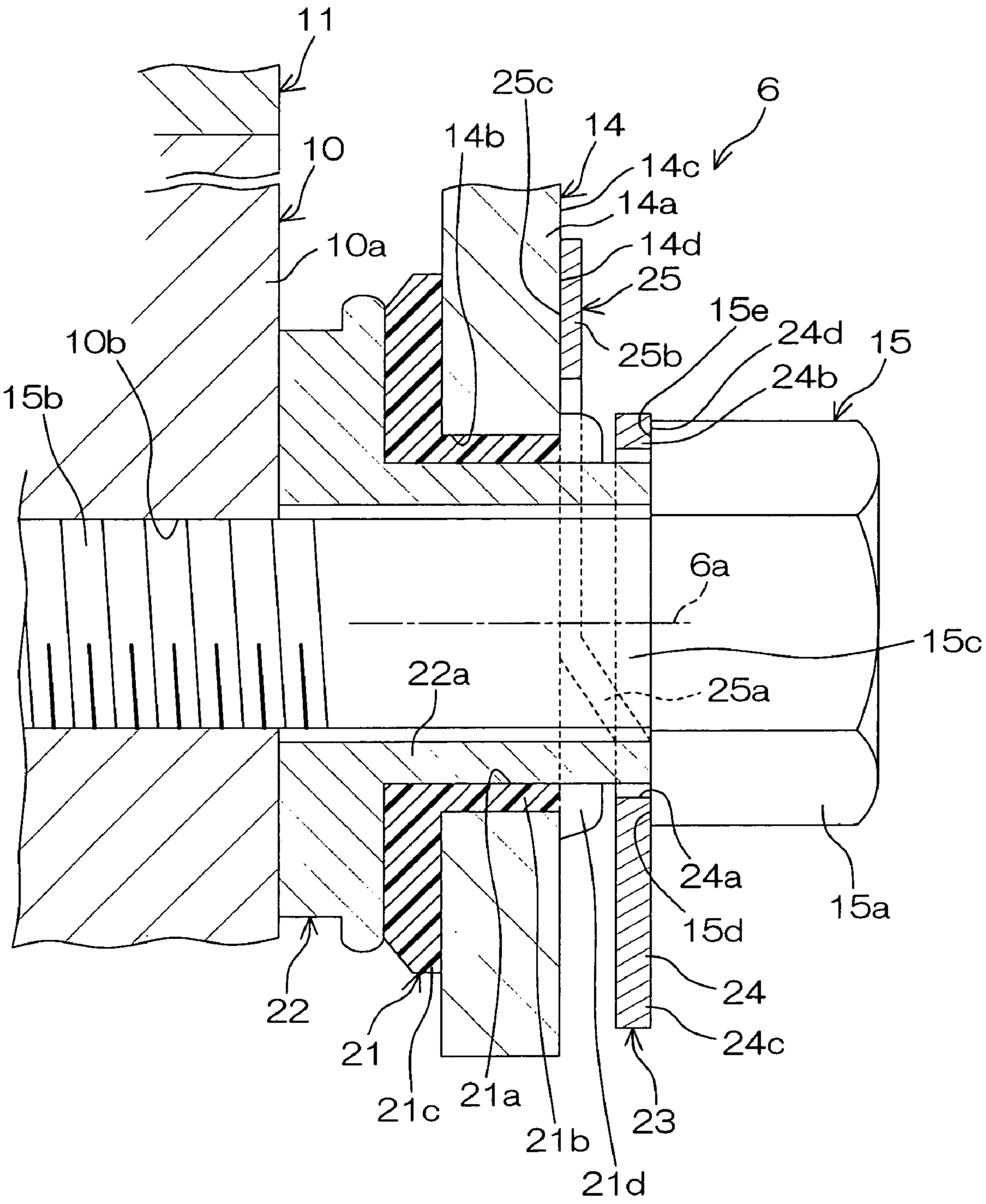


FIG. 2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15b
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14b
14
14c
14a
14d
25
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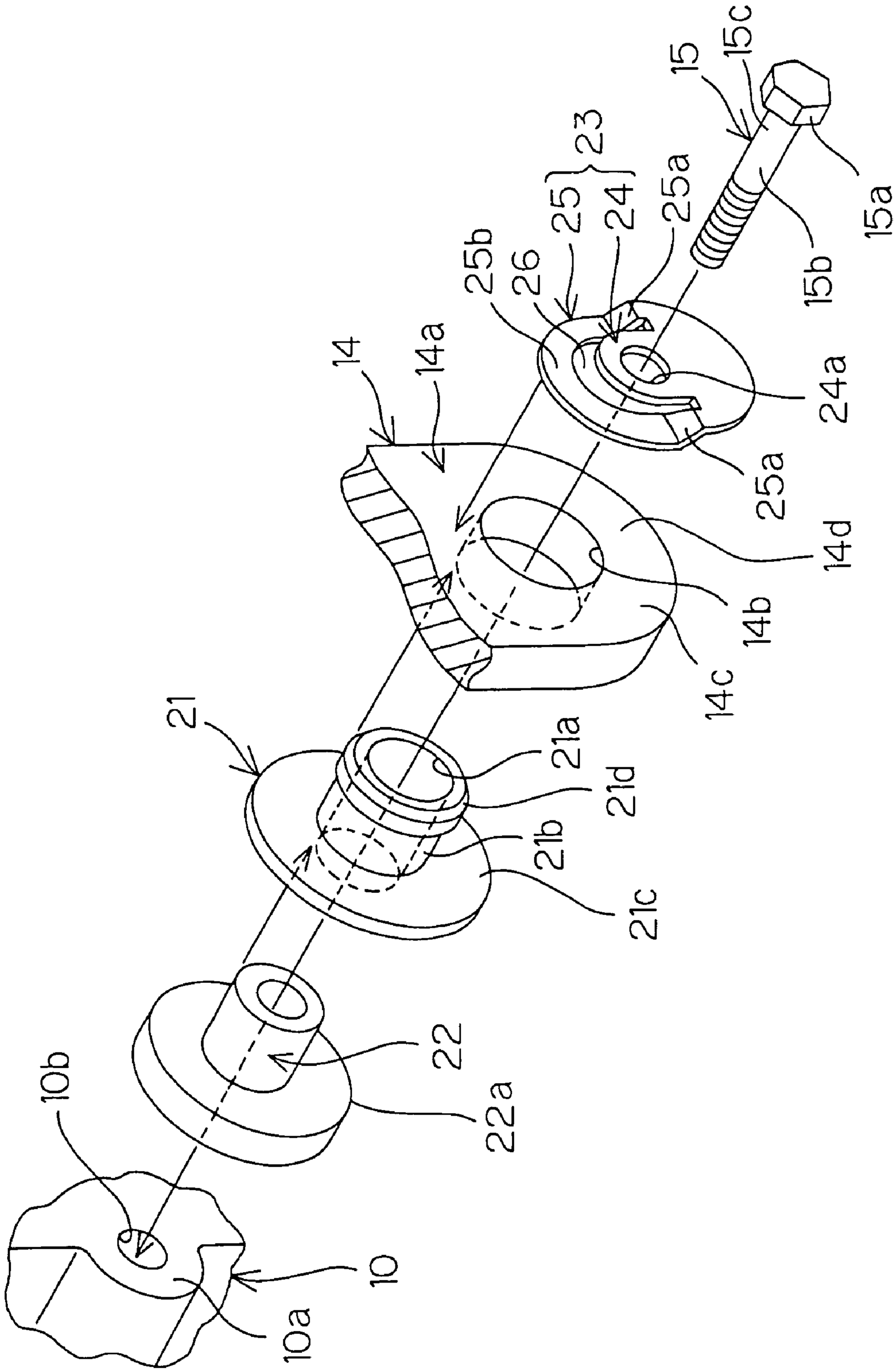
24b
6a
15c
22a
25a
24a
15a
15d
24
24c
22
21
21c
21a
21b
23
21d

FIG. 3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26
24a
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21d
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21c
22
22a
10b
10
10a

FIG. 4A

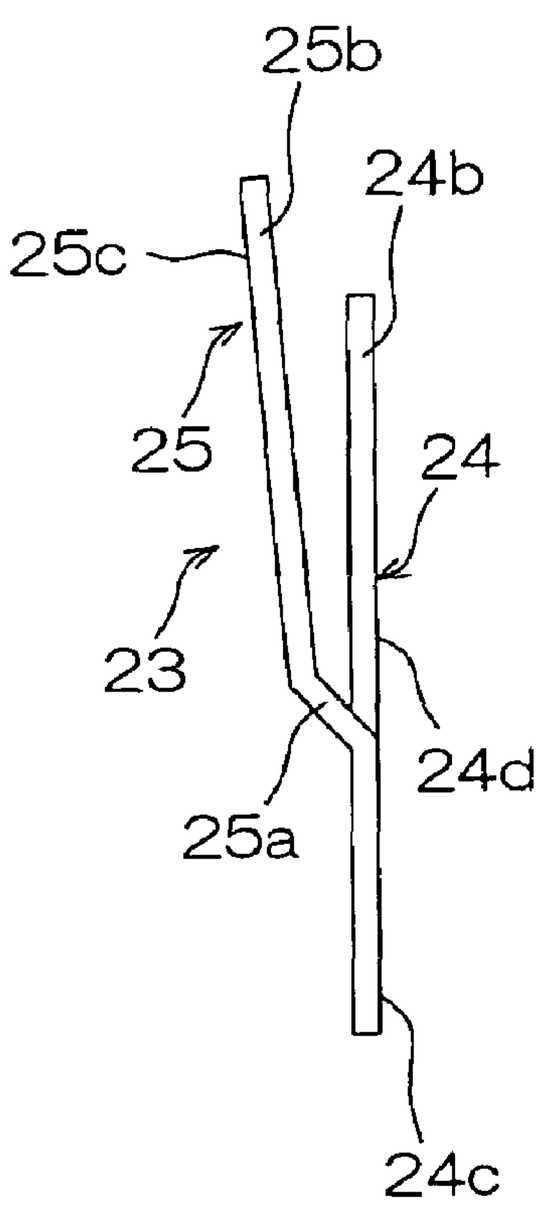
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FIG. 4B

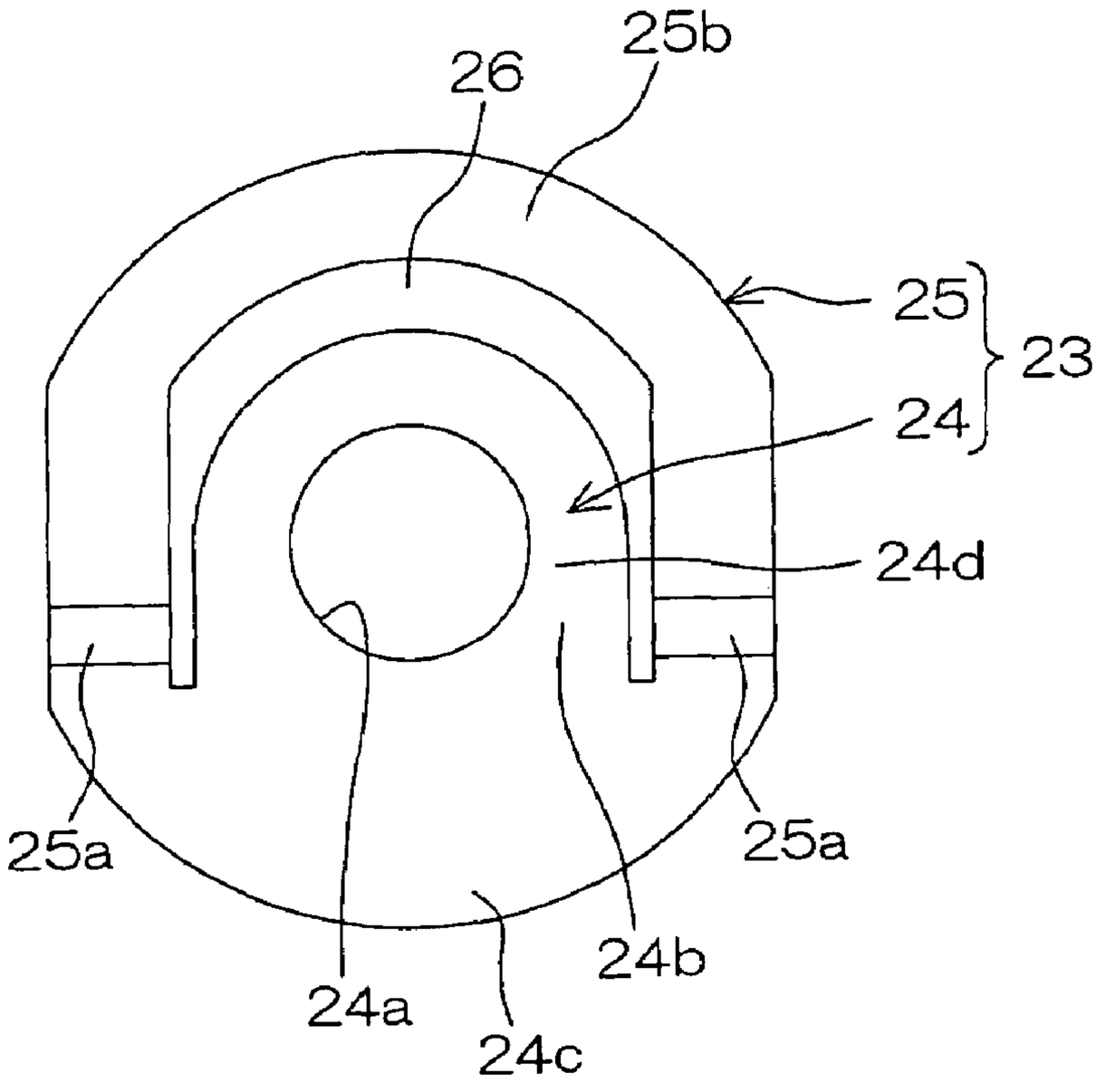
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FIG. 5

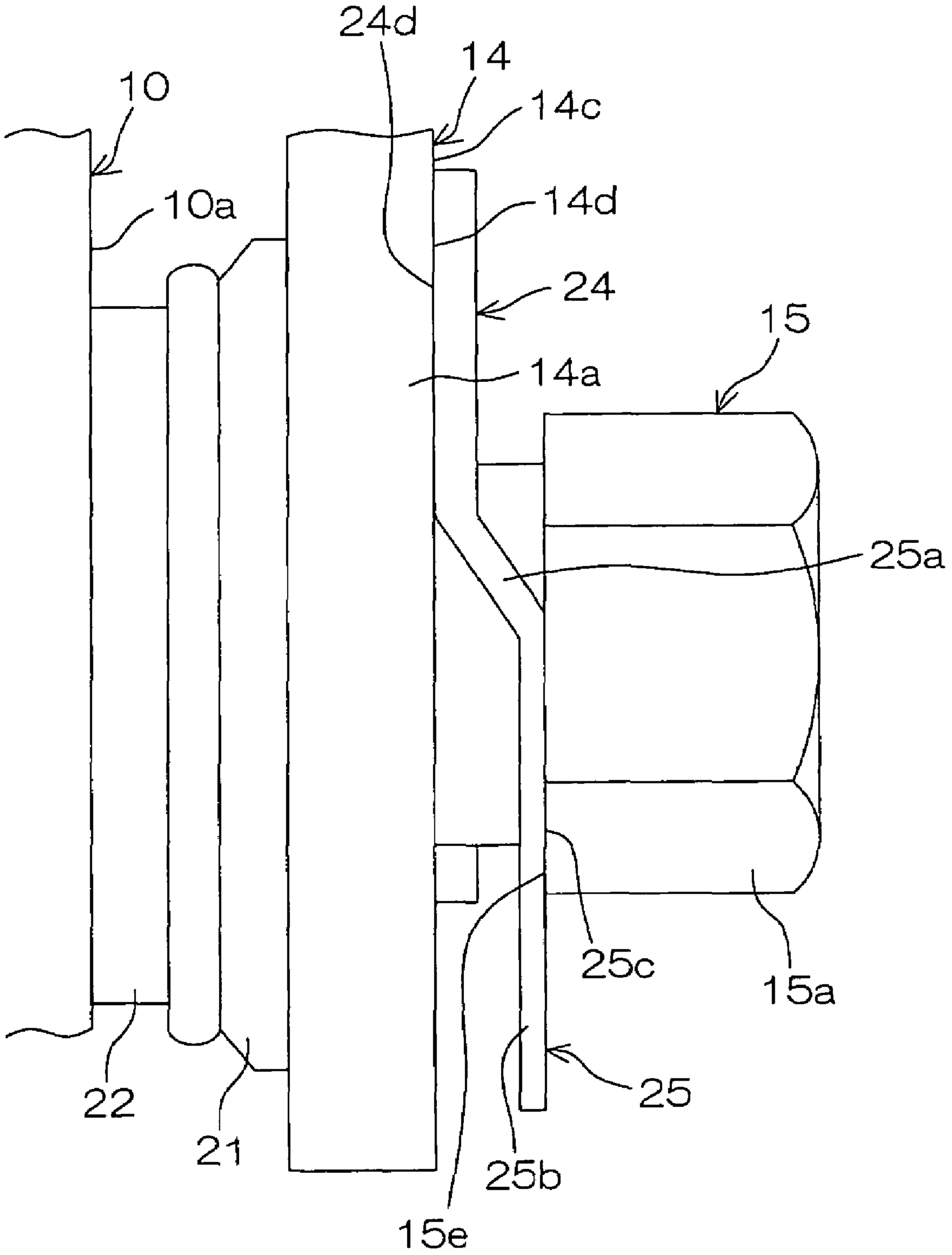
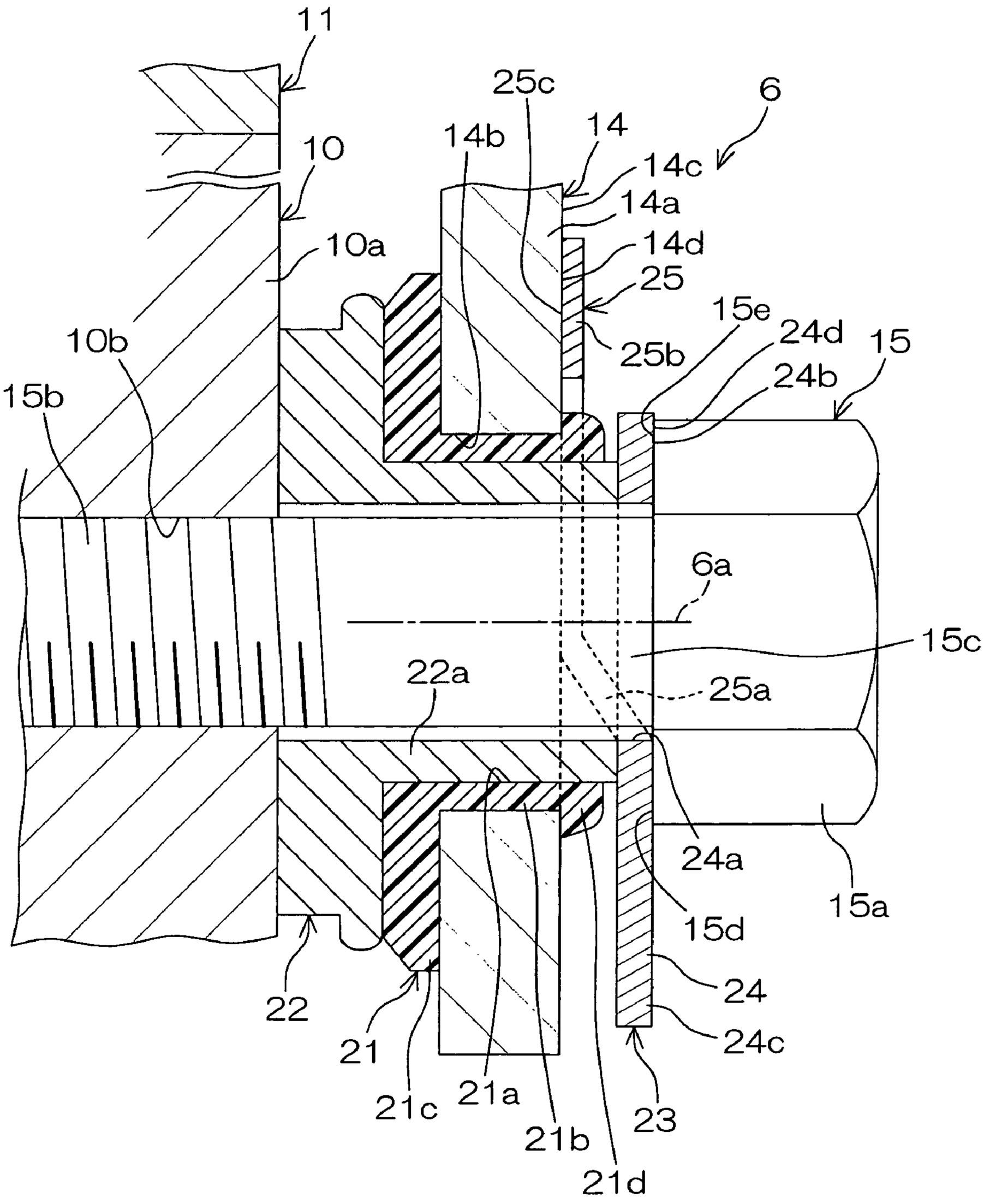


FIG. 6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10b
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25c
6
14b
14
14c
14a
14d
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25b
15e
24d
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24b
6a
15c
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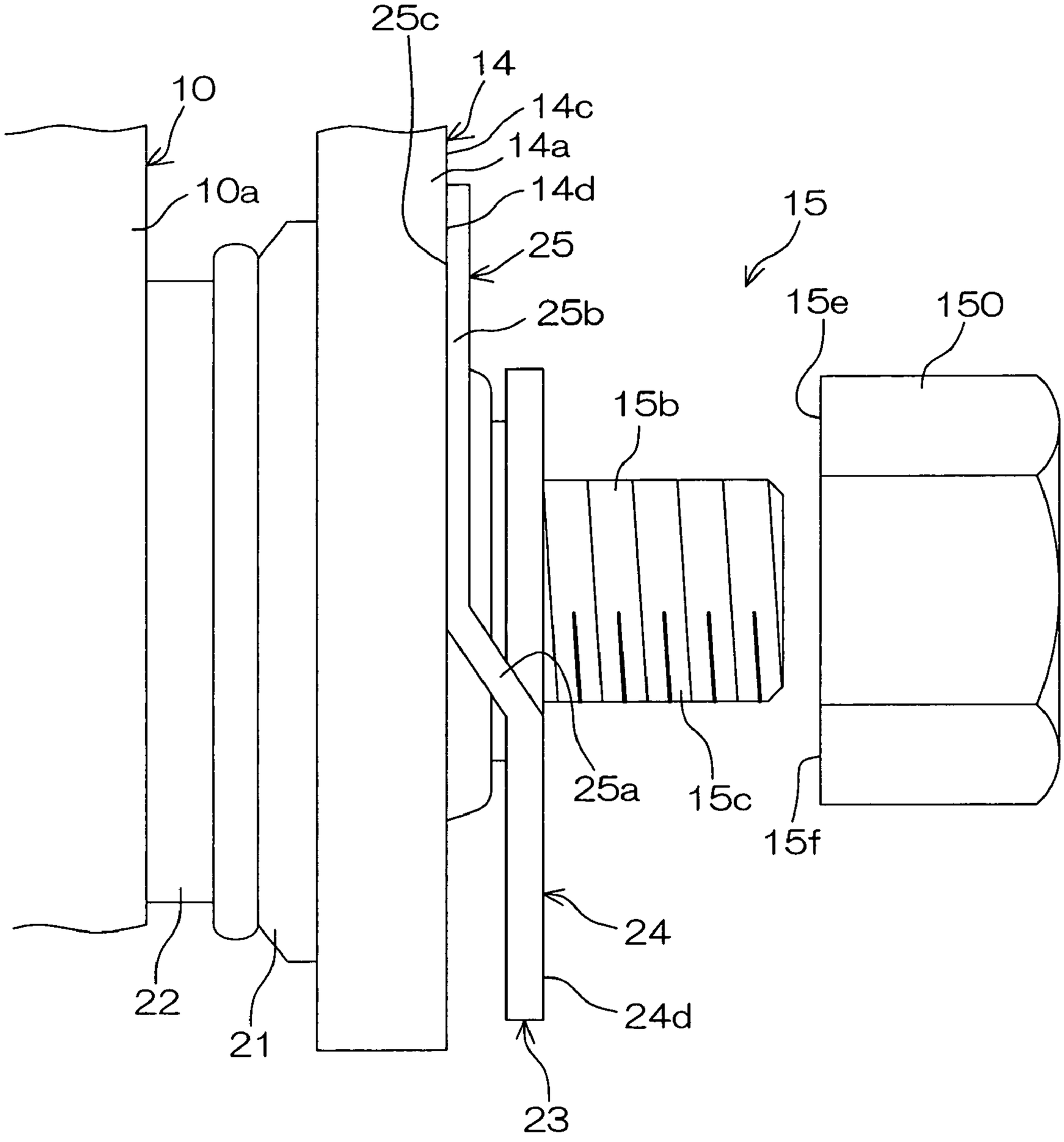
24a
15d
15a
24
24c
22
21
21c
21a
21b
23
21d

FIG. 7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15c
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22
21
23

FIG. 8A

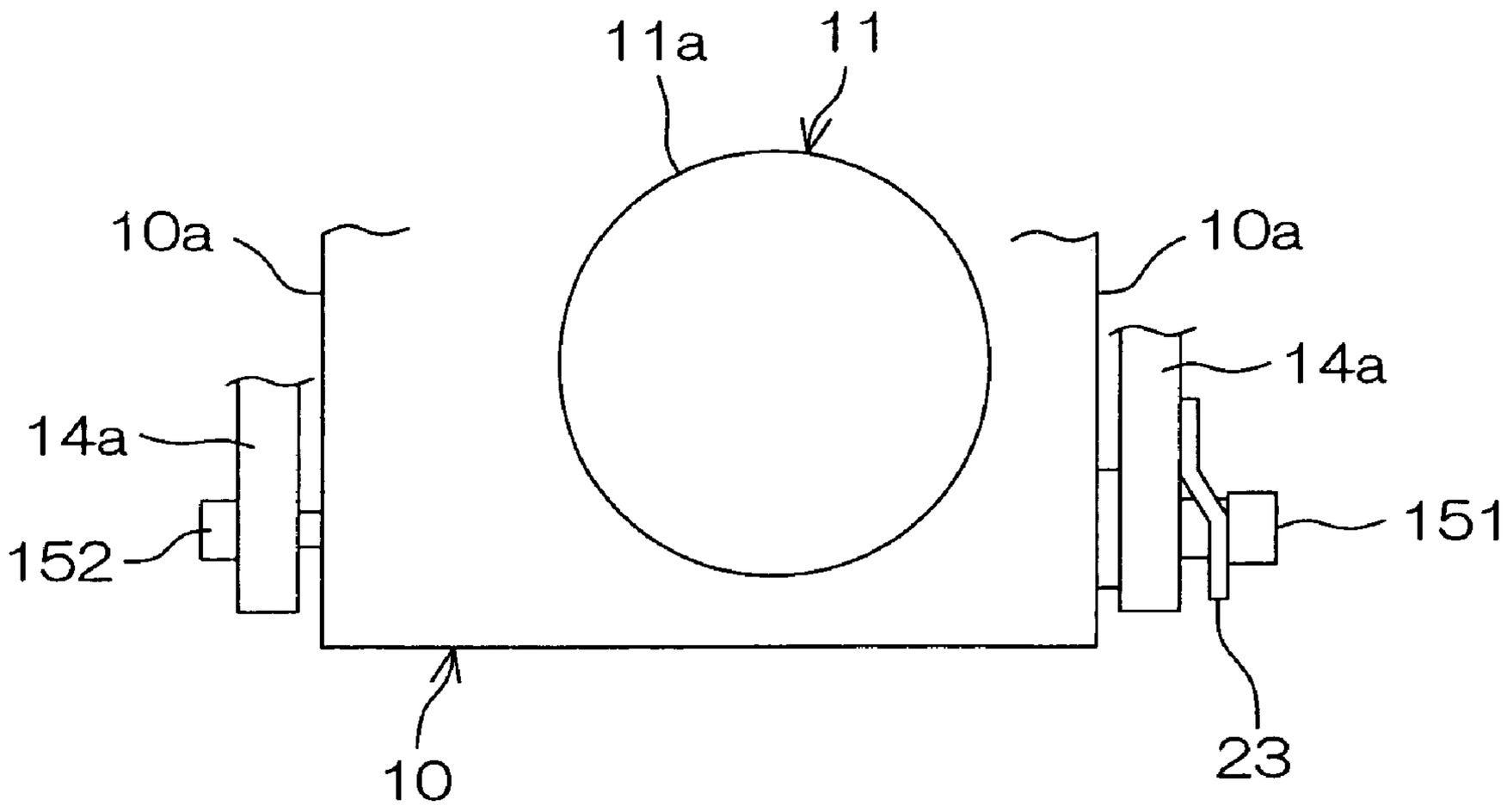
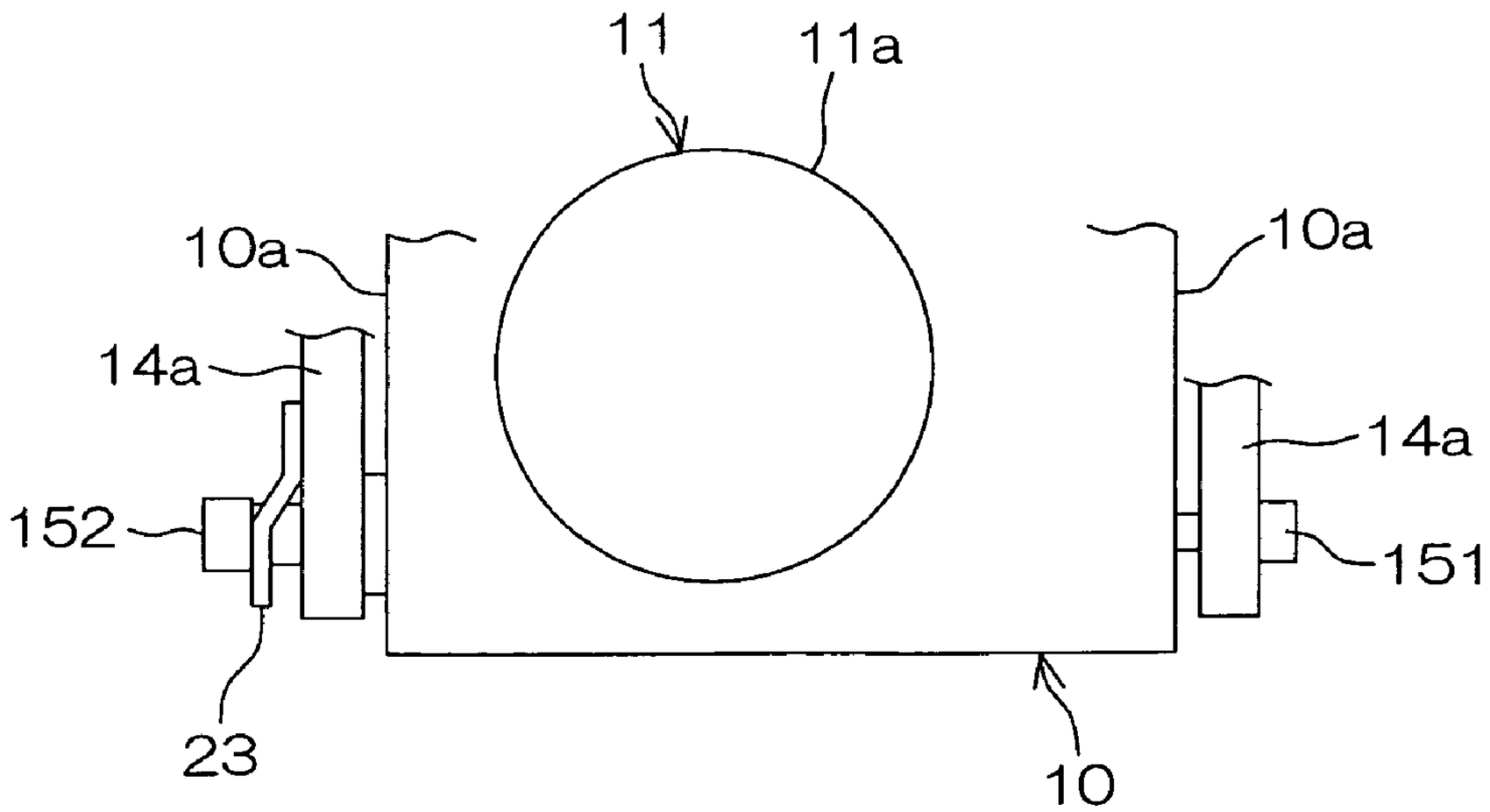

11a
11
10a
10a
14a
14a
152
151
10
23

FIG. 8B


11
11a
10a
10a
14a
14a
152
151
23
10

TILT STEERING ASSEMBLY

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a steering assembly for use in automotive vehicles and the like.

2. Description of Related Arts

As a shock-absorbing steering assembly, there have heretofore been known a steering assembly wherein a bolt is inserted through a tubular intermediate member insulatively retaining a break-away bracket, a conducting washer extended from the break-away bracket and a steering support member, so that the intermediate member, the washer and the steering support member are integrally fastened between a head of the bolt and a nut threadedly engaged with a distal end of the bolt (Japanese Unexamined Utility Model Publication No. 62-15082).

In this case, the break-away bracket is grounded to a vehicle body by means of the washer, the intermediate member and the steering support member.

In another case, the break-away bracket and the washer may be provided as separate members, which may be electrically interconnected by means of a wire harness.

The aforesaid conducting washer is unable to establish conduction unless the washer is strongly clamped between the intermediate member and the nut.

Therefore, the aforementioned grounding structure using the aforesaid conducting washer is not applicable to a tilt steering assembly for establishing the conduction between members associated with a tilt support shaft and adapted to move relative to each other.

In the case where the wire harness is used to interconnect the members moved relative to each other during tilt adjustment, the wire harness must have such a length as to be sufficient for permitting the tilt adjustment. In a case where the members movable relative to each other are surrounded by a limited space, therefore, it is difficult to lay out the wire harness.

It is an object of the invention to provide a tilt steering assembly adapted for positive accomplishment of the electrical connection between the members movable relative to each other and for installation in the limited space.

SUMMARY OF THE INVENTION

For achieving the above object, one embodiment of the invention provides a tilt steering assembly comprising a steering column permitting tilt adjustment around a tilt central axis. The tilt steering assembly comprises: a conductive support shaft extended along the tilt central axis, conductively assembled to the steering column, and integrally rotated with the steering column during tilt adjustment; a conductive end member provided at an end of the support shaft; a conductive fixed side plate including a support hole for supporting the support shaft via an insulating member; and a conductive member interposed between the fixed side plate and the end member and having resilience for bringing the fixed side plate and the end member into conduction. The steering column is grounded by means of the support shaft, the end member, the conductive member and the fixed side plate.

According to the embodiment, the electrical connection (e.g., ground connection, as mentioned above) between the support shaft and the fixed side plate by means of the conductive member is favorably maintained even when the support shaft and the fixed side plate are moved relative to each other in conjunction with the tilt adjustment. As a result, the steering column can be positively grounded to the vehicle body. Since the conductive member is interposed between the end member at the end of the support shaft and the fixed side plate, it is easy to lay out the steering assembly even if the support shaft is surrounded by a limited space.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1**A, **1**B and **1**C are side views, each schematically showing an electric power steering assembly as a tilt steering assembly according to one embodiment of the invention, FIG. **1**A showing a state where the tilt of a steering wheel is adjusted to an intermediate position, FIG. **1**B showing a state where the tilt of the steering wheel is adjusted to an upper position, FIG. **1**C showing a state where the tilt of the steering wheel is adjusted to a lower position;

FIG. **2** is a schematic sectional view of a tilt hinge mechanism as viewed along the direction II in FIG. **1**;

FIG. **3** is an exploded perspective view of the tilt hinge mechanism of FIG. **2**;

FIG. **4**A is a side view of a conductive member whereas FIG. **4**B is a front view of the conductive member;

FIG. **5** is a schematic side view of a tilt hinge mechanism according to another embodiment hereof;

FIG. **6** is a schematic sectional view of a tilt hinge mechanism according to still another embodiment hereof;

FIG. **7** is an exploded side view of a tilt hinge mechanism according to still another embodiment hereof; and

FIG. **8**A is a schematic plan view showing an electric power steering assembly as a tilt steering assembly according to still another embodiment hereof. FIG. **8**B is a second schematic view.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A tilt steering assembly according to one embodiment of the invention will hereinbelow be described with reference to the attached drawings. FIG. **1**A is a side view schematically showing the general arrangement of an electric power steering assembly of the invention. FIG. **1**A is referred to.

The electric power steering assembly **1** includes: a steering shaft **3** for transmission of a steering torque applied to a steering wheel **2** to steer road wheels (not shown); and a steering column **4** for rotatably supporting the steering shaft **3** extended therethrough. One end **3***a* of the steering shaft **3** is connected to the steering wheel **2**, whereas the other end **3***b* thereof is connected to a steering mechanism via an unillustrated intermediate shaft and the like, the steering mechanism operative to steer the road wheels. When the steering wheel **2** is operated, the steering torque thereof is transmitted to the steering mechanism via the steering shaft **3** and the like, so that the road wheels can be steered.

The electric power steering assembly **1** is assembled to a vehicle-side member **5** (partially indicated by a dot-dash line) in a position where the steering wheel **2** is positioned upwardly so that a longitudinal length S of the steering column **4** is angled with respect to an anteroposterior direction of the vehicle.

The electric power steering assembly **1** includes: a tilt hinge mechanism **6** providing for pivotal support of a lower part of the longitudinal length S of the steering column **4** from the vehicle-side member **5**; and a support mechanism **7** providing for switchable support of a central part of the longitudinal length S of the steering column **4** from the vehicle-side member **5**, the switchable support wherein the

position of the central part is switched between a locked position and an unlocked position.

In the unlocked state, the electric power steering assembly **1** functions as a tilt steering assembly. As shown in FIGS. **1**B and **1**C, the tilt steering assembly provides the height adjustment of the steering wheel **2** by pivotally moving the steering column **4** around a tilt central axis **6***a* of the tilt hinge mechanism **6**.

While the embodiment is described by way of reference to a case where the tilt hinge mechanism **6** is applied to the electric power steering assembly **1**, the tilt hinge mechanism **6** may also be applied to a manual steering assembly.

Returning to FIG. **1**A, the steering column **4** includes: an upper tube **8** located at an upper part of the longitudinal length S thereof; a lower tube **9** located centrally of the longitudinal length S thereof; and a housing **10** located at a lower part of the longitudinal length S and fixed to the lower tube **9**.

The electric power steering assembly **1** includes: a torque sensor **12** associated with the steering shaft **3** for sensing a steering torque; an electric motor **11** for generating a steering assist force based on an output signal from the torque sensor **12**, a vehicle speed signal and the like; and a reduction mechanism **13** for reducing the speed of rotation of a rotary shaft **11***b* of the electric motor **11**.

When the steering wheel **2** is operated, the steering torque thereof is detected by the torque sensor **12** whereas the electric motor **11** generates the steering assist force based on the detected torque, the detected vehicle speed and the like. The steering assist force is transmitted to the steering shaft **3** via the reduction mechanism **13** so as to be transmitted to the steering mechanism in conjunction with the motion of the steering wheel **2**. Thus, the road wheels are steered. The electric power steering assembly **1** comprises a motor housing **11***a* of the electric motor **11** assembled to the housing **10** of the steering column **4**, the electric motor operating to provide the steering assist. The housing **10** of the steering column **4** and the motor housing **11***a* of the electric motor **11** are formed of a metal member as a conductive member, such as an aluminum alloy member. The housing **10** of the steering column **4** and the motor housing **11***a* of the electric motor **11** are mechanically connected with each other by means of a screw, for example. Furthermore, the steering column housing **10** and the motor housing **11***a* are electrically connected with each other via a pair of contact portions thereof (not shown in FIG. **1**A) on which the housings **10** and **11***a* contact each other.

The housing **10** accommodates and supports the reduction mechanism **13** and the torque sensor **12**. The tilt hinge mechanism **6** is assembled to the housing **10**. There may be a case, as shown in FIG. **1**A, where the housing **10** comprises a single member unitizing a first housing accommodating the torque sensor **12** and a second housing accommodating the reduction mechanism **13**. In an alternative case, the first and second housings may be combined with each other to form the housing **10**.

In order to provide for the support of the housing **10** of the steering column **4** from the vehicle-side member **5**, the tilt hinge mechanism **6** includes: a lower fixed bracket **14** fixed to the vehicle-side member **5**; and bolts **15** constituting a pair of tilt support shafts, which are mounted to the housing **10** as rotatably supported by the lower fixed bracket **14**. The tilt hinge mechanism **6** is mounted to lateral opposite sides of the steering column **4** in a similar fashion.

The support mechanism **7** includes: an upper fixed bracket **16** fixed to the vehicle-side member **5**; a support shaft **17** supported by an elongate hole **16***b* in a side plate **16***a* of the upper fixed bracket **16**; an upper bracket **18** fixed to the upper tube **8** of the steering column **4** as supported by the support shaft **17**; and a lock mechanism **19** provided at the support shaft **17** for releasably locking the position of the steering column **4**.

The lock mechanism **19** includes: a cam mechanism (not shown) for pressing the corresponding side plates **16***a*, **18***a* of the brackets **16**, **18** against each other; and an operation lever **20** for operating the cam mechanism. In the unlocked state, the tilt hinge mechanism **6** permits the tilting motion of the steering column **4**.

FIGS. **2** and **3** are referred to. FIGS. **2** and **3** show the tilt hinge mechanism **6** disposed on one of the lateral sides of the steering column **4**.

The bolt **15** of the tilt hinge mechanism **6** is constituted by, for example, a hexagon head bolt which is formed of a metal member as a conductive member, such as a steel member. The bolt **15** includes a head **15***a*, and a threaded shank **15***b* formed with a male thread. The head **15***a* constitutes an end member provided at an end **15***c* of the threaded shank **15***b*. The aforesaid tilt axis **6***a* is defined by an axis of the threaded shank **15***b* of the bolt **15**.

The housing **10** of the steering column **4** includes: a pair of side portions **10***a* in opposing relation; and a pair of screw holes **10***b* each formed, as a fixing portion, in each of the pair of side portions **10***a*. The bolt **15** is screwed into each of the screw holes **10***b* so that each bolt **15** and the housing **10** are electrically connected with each other.

The lower fixed bracket **14** is fixed to the vehicle-side member **5**. The lower fixed bracket **14** includes: a pair of fixed side plates **14***a*; and a pair of support holes **14***b* each formed in each of the fixed side plates **14***a*. Each side plate **14***a* is disposed in face-to-face relation with an outer side of the corresponding side portion **10***a* of the housing **10**. Each bolt **15** extends through the corresponding support hole **14***b* to be screwed into the corresponding screw hole **10***b* of the housing **10**.

According to the embodiment, the tilt hinge mechanism **6** further includes: a pair of bushes **21**, as an insulating member, each mounted in each of the pair of support holes **14***b* of the lower fixed bracket **14**; a pair of collars **22** each relatively rotatably fitted in a corresponding one of holes **21***a* of the pair of bushes **21**; and a pair of conductive members **23** for establishing electrical connection between the steering column **4** and the vehicle-side member **5**.

The collar **22** is formed of a metal member as a hard member. The collar **22** includes: a tubular portion **22***a* through which the threaded shank **15***b* of the bolt **15** is inserted; and an annular flange **22***b* formed at an end of the tubular portion **22***a* and extended radially outwardly therefrom. The collar **22** is clamped between the side portion **10***a* of the housing **10** of the steering column **4** and the head **15***a* of the bolt **15**. When tilt adjustment is made, the collar **22** is turned in unison with the housing **10** and the bolt **15**.

The bush **21** is formed of a synthetic resin member such as to be able to rotate relative to the collar **22** with low friction. The bush **21** includes: a tubular portion **21***b* formed with the hole **21***a* on an inner side thereof; a flange **21***c* radially outwardly extended from one end of the tubular portion **21***b*; and a greater diameter portion **21***d* formed on an outside circumference of the other end of the tubular portion **21***b*. The flange **21***c* is interposed between the fixed side plate **14***a* of the lower fixed bracket **14** and the side portion **10***a* of the bracket **10** so as to keep the fixed side plate **14***a* and the side portion **19***a* out of contact.

An outer periphery of the tubular portion **21***b* is fitted in an inner periphery of the support hole **14***b* in the fixed side

plate **14***a* of the lower fixed bracket **14**. An outside diameter of the greater diameter portion **21***d* is greater than an outside diameter of the support hole **14***b*. The flange **21***c* and the greater diameter portion **21***d* are located on the opposite sides of the fixed side plate **14***a*, which define circumferential edges of the support hole **14***b*, whereby the bush **21** is prevented from disengaging from the support hole **14***b*.

A seat **15***d* of the head **15***a* of the bolt **15** and an outside surface **14***c* of the fixed side plate **14***a* of the lower fixed bracket **14** define opposite faces in face-to-face relation. A predetermined amount of gap is defined between the seat **15***d* and the outside surface **14***c* as the opposite faces. The conductive member **23** is disposed in the gap as resiliently deformably clamped between these faces.

FIGS. **2**, **4**A and **4**B are referred to. The conductive member **23** is formed of a metal material as a conductive material, such as a spring steel, thus having resilience. Specifically, the conductive member **23** includes: a main body **24** having a through hole **24***a* for insertion of the bolt **15** therethrough; and a resilient piece (U-shaped portion) **25** extended from the main body **24** and resiliently supported by the body. In an assembled state shown in FIG. **2**, the main body **24** is positioned close to the head **15***a* of the bolt **15** whereas the resilient piece **25** is positioned close to the fixed side plate **14***a* of the lower fixed bracket **14**.

The conductive member **23** comprises a sheet metal article unitizing the main body **24** and the resilient piece **25**, the resilient piece **25** formed by cutting a portion of the sheet metal article and bending out the cut portion. As seen in a plan view of FIG. **4**B, the conductive member **23** includes a slit **26** defined in a U-shape between the main body **24** and the resilient piece **25** in order to permit relative movement between the resilient piece **25** and the main body **24**.

Referring to FIGS. **4**A and **4**B showing a free state of the conductive member **23**, the main body **24** includes: a first annular portion **24***b* located substantially centrally of the conductive member **23** as seen in plan and defining a circumferential portion of the through hole **24***a*; and a second portion **24***c* defining a semi-circle having a greater diameter than the first portion **24***b* and continuous to the first portion **24***b*. The first portion **24***b* and the second portion **24***c* are formed flush with each other. The first portion **24***b* of the main body **24** includes a contact portion **24***d* adapted to contact a contact portion **15***e* defined at the seat **15***c* of the head **15***a* of the bolt **15** so as to establish electrical connection therewith.

The resilient piece **25** comprises a U-shaped portion which is extended from opposite sides of the second portion **24***c* of the main body **24** to define a U-shape (depicted as an inverted U in FIG. **4**B) and is supported by the main body **24** in a straddle mounting fashion. The resilient piece **25** opposes to a circumference of the first portion **24***b* of the main body **24** via the slit **26**. The resilient piece **25** in a free state is configured as a two-step bent, including a first portion **25***a* defining a pair of ends continuous to the second portion **24***c* of the main body **24** and inclining relatively steeply; and a second portion **25***b* defining a U-shaped intermediate portion interconnecting these first portions **25***a* and inclining relatively gently. The resilient piece is yieldable as resiliently deformed to vary the inclinations of the portions **25***a*, **25***b* thereof.

The resilient piece **25** establishes electrical connection with the outside surface **14***c* of the fixed side plate **14***a* by resiliently bringing its contact portion **25***c* defined at the second portion **25***b* thereof into face contact with a contact portion **14***d* defined by a circumferential portion of the support hole **14***b* (see FIG. **2**).

In the assembled state shown in FIG. **2**, the conductive member **23** is so clamped as to be resiliently deformed along an axial direction of the bolt **15**. In a state where the second portion **25***b* of the resilient piece **25** is substantially parallel with the main body **24**, the contact portion **24***c* of the main body **24** resiliently contacts the corresponding head **15***a* of the bolt **15**, while the contact portion **25***c* of the second portion **25***b* of the resilient piece **25** resiliently contacts the corresponding fixed side plate **14***a* of the lower fixed bracket **14**. In this state, the conductive member **23** is capable of applying oppositely directed biasing forces such as to bias the head **15***a* and the fixed side plate **14***a* away from each other.

Returning to FIG. **2**, the embodiment of the invention is arranged such that the bolt **15** can establish the electrical connection with the housing **10** of the steering column **4** as assembled thereto.

Even when the bolt **15** and the fixed side plate **14***a* of the lower fixed bracket **14** are moved relative to each other so as to vary the gap therebetween, the conductive member **23** can assuredly accomplish the resilient contact with the head **15***a* of the bolt **15** and with the fixed side plate **14***a* of the lower fixed bracket **14**. That is, the conductive member may be stably held in sliding contact or pressure contact with the head **15***a* and with the fixed side plate **14***a*. Thus, the conductive member can ensure the electrical connection between the bolt **15** and the lower fixed bracket **14**. Therefore, the electrical connection between the lower fixed bracket **14** and the vehicle-side member **5** to which the bracket is fixed, and between the lower fixed bracket and the steering column **4** can be accomplished assuredly.

Furthermore, the vehicle-side member **5** can be electrically connected with the motor housing **11***a* of the electrical motor **11** by means of the lower fixed bracket **14**, the conductive member **23**, the bolt **15** and the housing **10** of the steering column **4**.

In addition, the conductive member **23** is mostly incorporated in the tilt hinge mechanism **6** and hence, the conductive member does not interfere with components disposed in a surrounding space even when the surrounding space is limited. This leads to an easy layout of the conductive member **23**.

The conductive member **23** may be assembled utilizing an operation of mounting the bolt **15** to the housing **10**, the operation essentially required for assembling the tilt hinge mechanism **6**. This obviates an operation of mounting the conductive member **23**.

The main body **24** and the resilient piece **25** resiliently contact the respectively corresponding head **15***a* of the bolt **15** and fixed side plate **14***a* of the lower fixed bracket **14**, thereby more positively accomplishing the electrical connection. In addition, the main body **24** including the through hole **24***a* for insertion of the bolt **15** therethrough is configured to be temporarily retained on the bolt **15** during assembly. Therefore, the conductive member may be readily clamped and assembled.

The resilient piece **25** is supported in the straddle mounting fashion such that the resilient piece **25** may be brought into a more stable contact than in a case where the resilient piece **25** is supported in a cantilever fashion. Hence, the resilient piece can even more assuredly accomplish the electrical connection.

Since the resilient piece **25** comprises the U-shaped portion, the resilient piece **25** may be disposed in a small space around the bolt **15** and besides, an increased area may be involved in the electrical connection.

The head **15***a* of the bolt **15** and the main body **24**, as well as the second portion **25***b* of the resilient piece **25** and the fixed side plate **14***a* are brought into face contact with each other. More preferably, the surfaces of the sheet metal article constituting the conductive member **23** conform to the counterpart members, such as the head **15***a* and the fixed side plate **14***a*, so that these components are less likely to be caught during the relative sliding movement. This results in the reduction of sliding resistance.

The second portion **25***b* of the resilient piece **25** is extended substantially along a circumferential direction of the bolt **15** and in a direction perpendicular to a direction in which the second portion **25***b* is clamped between the head **15***a* and the fixed side plate **14***a*. Therefore, the second portion **25***b* may be reduced in the sliding resistance as subjected to the clamping force. As a result, the tilt adjustment may be accomplished with less force.

The conductive member **23** may be assembled easily by using the bolt **15**. In addition, the bolt **15** may employ, for example, a commercially available bolt which is less costly. This results in the further cost reduction of the tilt hinge mechanism **6**.

Since the conductive member **23** is adapted for resilient contact against the fixed side plate **14***a* and the head **15***a*, the conductive member can accommodate dimensional errors, assembly errors and such. Furthermore, the conductive member **23** may have the pressing force against the counterpart member set to a substantially low constant value and hence, the sliding resistance during the tilt adjustment can be reduced.

Where the conductive member **23** is composed of a single sheet metal article, the conductive member may be produced at lower costs. For instance, the conductive member may be produced at lower costs than a conventional wire harness.

The conductive member **23** may preferably be applied to the electric power steering assembly, or more preferably to the electric power steering assembly wherein the motor housing **11***a* of the electric motor **11** for providing the steering assist is assembled to the housing **10** of the steering column **4**. Specifically, the motor housing **11***a* of the electric motor **11** is electrically connected with the vehicle-side member **5** and grounded thereto by means of the conductive member **23**. Therefore, the motor housing **11***a* thus grounded is capable of shielding electromagnetic wave occurring in the electric motor **11**. As a result, the energized electric motor **11** may be prevented from causing noises of an automotive radio.

The tilt hinge mechanism **6** including the conductive member **23** may be applied not only to the electric power steering assembly **1** but also to a case where the steering column **4** is utilized as a part of an electric circuit, thereby ensuring that the function of the electric circuit is fully exhibited.

Other embodiments of the invention will be illustrated as below. In the following description, like parts to those of the embodiment of FIG. **3** are represented by like reference characters, respectively, the description of which is dispensed with.

As shown in FIG. **5**, there may be a case where the main body **24** of the conductive member **23** contacts the fixed side plate **14***a* while the resilient piece **25** thereof contacts the head **15***a* of the bolt **15**.

As shown in FIG. **6**, there may be a case where the main body **24** of the conductive member **23** is clamped between the collar **22** and the head **15***a* of the bolt **15** while only the second portion **25***b* resiliently contacts the fixed side plate **14***a*.

Although not shown in a figure, there may be a case where only the main body **24** of the conductive member **23** is resiliently pressed against the head **15***a*. In another case, the main body **24** of the conductive member **23** may cantilever the resilient piece **25**. The bolt **15** as the tilt support shaft may be replaced by a column member formed with a greater diameter portion as an end member, the column member assembled to the side portion **10***a* of the housing **10** by press fit or the like.

As shown in FIG. **7**, there maybe a case where a nut **150** is employed as the end member which threadedly engages the end **15***c* of the threaded shank **15***b*. FIG. **7** shows the contact portion **15***e* and also shows a portion **15***f* on the diametrically opposite face of the nut **150** which contacts the contact portion **24***d* of the conductive member **23**.

It may be considered to omit the bush **21** and the collar **22**. In this case, as well, the conductivity can be enhanced by the conductive member **23**.

As shown in FIG. **8**A and FIG. **8**B, the conductive member **23** may be provided in association with only one of the pair of bolts **151**, **152** as the tilt support shafts. In the case of FIG. **8**A, the conductive member **23** may preferably be disposed at the bolt **151** (the right-hand bolt **151** as seen in FIG. **8**A) which is relatively closer to the motor housing **11***a* of the electric motor **11**. Thus is reduced a distance between the motor housing **11***a* of the electric motor **11** and the conductive member **23**, so that the conductivity may be increased for effective noise reduction. FIG. **8**B illustrates that motor housing **11** is positioned relatively closer to the bolt **152** (the left-hand support shaft as seen in FIGS. **8**A and **8**B), and the conductive member **23** is provided to the bolt **152** which is used as a support shaft, again with shortening of the electrical path and reduced noise.

While the invention has been described in details by way of reference to the specific embodiments thereof, variations, modifications and equivalents thereto will readily occur to those skilled in the art who have fully understood the contents of the foregoing description. The scope of the invention is therefore to be defined by the appended claims and the equivalents thereto.

The present application is in correspondence to Patent Application No. 2003-173880 filed with Japanese Patent Office on Jun. 18, 2003, and the whole disclosure thereof is incorporated herein by reference.

What is claimed is:

1. A tilt steering assembly comprising a steering column permitting tilt adjustment about a tilt central axis, the tilt steering apparatus further comprising:

at least one electrically conductive support shaft coaxial with the tilt central axis, electrical-conductively assembled to the steering column, and unitarily rotated with the steering column during the tilt adjustment;

an electrically conductive end member provided at an end of the support shaft;

an electrically conductive fixed side plate including a support hole for supporting the support shaft; and

an electrically conductive member interposed between the fixed side plate and the end member, and having resilience for bringing the fixed side plate and the end member into electrical conduction;

a bush formed of electrically insulative synthetic material and comprising a tubular portion and a flange disposed at one end of the tubular portion;

wherein the tubular portion is interposed between an inner circumference of the support hole of the fixed side plate

and an outer circumference of the support shaft, and the flange is interposed between the steering column and the fixed side plate;

wherein the fixed side plate and the end member of the support shaft are spaced away from each other in an axial direction of the support shaft; and

further comprising an electric steering-assist motor;

wherein the electric motor includes a motor housing electrical-conductively mounted on the steering column; and

wherein said steering column is grounded by means of the support shaft, the end member, the conductive member and the fixing side plate.

2. A tilt steering assembly according to claim **1**,

wherein the conductive member is formed from a single sheet metal in one piece.

3. A tilt steering assembly according to claim **1**,

wherein the support shaft includes a threaded shank fixed in a fixing hole of the steering column

further comprising a collar inserted through the support hole of the fixed side plate and surrounding the threaded shank,

wherein the collar is clamped between the end member and a side portion of the steering column, and

wherein the collar constitutes a metal member, and

the bush enclosing a periphery of the collar as rotatably supporting the collar.

4. A tilt steering assembly according to claim **1**,

further comprising:

a reduction mechanism for reducing an output rotation of the electric motor,

wherein the steering column accommodates at least the reduction mechanism and includes a housing conductively assembled to a motor housing of the electric motor, and

wherein the support shaft unitarily rotatably assembled to the housing of the steering column.

5. A tilt steering assembly according to claim **4**,

wherein the at least one support shaft includes a support shaft relatively close to the electric motor and a support shaft relatively far away from the electric motor, the conductive member mounted only to the support shaft close to the electric motor.

6. A tilt steering assembly according to claim **1**,

wherein the support shaft includes a threaded shank fixed in a fixing hole of the steering column.

7. A tilt steering assembly according to claim **6**,

wherein the end member includes a head formed from a single member integrally with the threaded shank.

8. A tilt steering assembly according to claim **6**,

wherein the end member includes a nut threadedly engaged with the threaded shank.

9. A tilt steering assembly according to claim **6**,

further comprising a collar inserted through the support hole of the fixed side plate and surrounding the threaded shank,

wherein the collar is clamped between the end member and a side portion of the steering column.

10. A tilt steering assembly according to claim **1**,

wherein the end member and the fixed side plate include individual surfaces opposing each other, respectively,

wherein the conductive member includes a pair of contact portions individually contacting the respective opposing surfaces of said end member and the fixed side plate,

wherein at least one of the pair of contact portions resiliently contacts the corresponding opposing surface.

11. A tilt steering assembly according to claim **10**,

wherein the conductive member includes a main body having a through hole for insertion of the support shaft therethrough, and a resilient piece extended from the main body, the pair of contact portions provided at the main body and the resilient piece, respectively.

12. A tilt steering assembly according to claim **11**,

wherein the resilient piece includes a U-shaped portion, the U-shaped portion including a pair of ends each supported by the main body.

13. A tilt steering assembly according to claim **12**,

wherein the U-shaped portion further includes an intermediate portion interposed between the pair of ends,

wherein the pair of ends of the U-shaped portion each includes a first portion inclined relative to the main body,

wherein the intermediate portion of the U-shaped portion includes a second portion inclined more gently than the first portion in a free state.

14. A tilt steering assembly according to claim **12**,

wherein the main body and the intermediate portion of the U-shaped portion are spaced away from each other in a direction along the tilt central axis.

15. A tilt steering assembly according to claim **12**,

wherein the U-shaped portion and the main body define a U-shaped slit therebetween.

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